NEW WORLD VISTAS

Looking toward the Future, Learning from the Past

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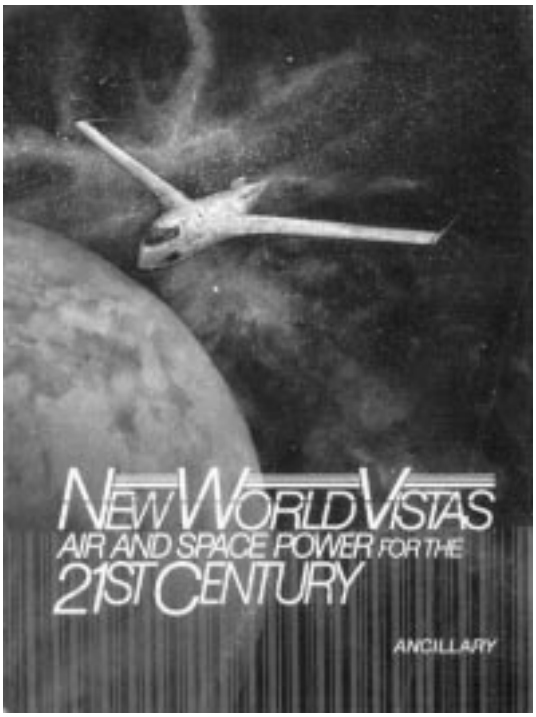

OVER FIVE DECADES ago, the Army Air Forces initiated the first technology forecast in military history. The report, *Toward New Horizons,* was written by a team of 31 scientists—all experts in their fields—led by Dr. Theodore von Kármán, the eccentric California Institute of Technology (CalTech) aerodynamicist. Since this first science and technology (S&T) study, the US Air Force has sponsored a major S&T study once each decade. It has been five years since the commencement of the most recent study, *New World Vistas: Air and Space Power for the 21st Century.* Looking back at the yearlong study reveals much about the evolution of the Air Force over the past 60 years.

At the National Academy of Sciences (NAS) building in Washington, D.C., on 10 November 1994, Secretary of the Air Force Sheila Widnall approached the podium before an audience of scientists, Air Force personnel, and at least two historians to deliver her opening remarks for the 50th anniversary gathering of the Air Force Scientific Advisory Board (SAB). She spoke of the émigré Hungarian aeronautical scientist, Kármán, and a career Army Air Forces officer, General of the Air Force Henry "Hap" Arnold, who came together under the pressures of World War II and formed the Scientific Advisory Group (SAG), the forerunner of the SAB, in the fall of 1944. The SAG's purpose was to forge a detailed plan, a blueprint for the future development of the Army Air Forces. The group was to travel the world, investigate all possible roads of inquiry, and determine how best to pursue new technologies and build a superior air force. Through the spring and summer of 1945, this group of scientists traveled to Germany, England, Japan, the Soviet Union, and many countries in between searching for the finest minds and most advanced laboratories that had, on occasion, nearly tipped the scales of victory in favor of the Axis. The preliminary report, *Where We Stand,* and the final report, *Toward New Horizons,* became the blueprints for the building of the scientific and technological infrastructure of today's Air Force.

The secretary's references to Arnold and Kármán were nothing new. In fact, every time any major Air Force S&T study had been initiated over the past five decades, eloquent speakers had evoked the words and deeds of the two architects of American air su-

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Arnold awards Kármán the Meritorious Civilian Service Award for his work on Toward New Horizons, *February 1946.*

premacy.[1] This occasion turned out to be no different from times past. As she spoke, Dr. Widnall's voice—determined, comfortable, clear, and focused—challenged Dr. Gene McCall and his 1994 Scientific Advisory Board to "rekindle that inquisitive attitude" initiated by Kármán's group some 50 years earlier. McCall was challenged to write a report in the Kármán tradition. The report, *New World Vistas*: *Air and Space Power for the 21st Century,* was completed on 15 December 1995, exactly 50 years after Kármán's report was placed on General Arnold's desk.

New World Vistas, formally delivered during a senior staff briefing in the secretary's conference room in the Pentagon, was more like Kármán's first report than any of the others that had been written each decade following *Toward New Horizons*. This was not an accidental occurrence. There were similarities that reflected a cognizance of history, and there were differences that reflected the evolution of science, technology, and society in this country over the past five decades.

This article relates some of my observations as the historian attached to the Air Force Scientific Advisory Board. Then I will make a few comparisons between the first Kármán study and the latest McCall study.

My association with the SAB began as an outcropping of dissertation research. In 1993, at the suggestion of Duane Reed, of the US Air Force Academy Special Collections Branch, I embarked upon a biographical study of General Arnold and Dr. Kármán. In

the summer of 1994, I contacted Col Timothy Courington, executive director of the SAB, to arrange to attend the 50th anniversary gathering of the SAB that November. It is my opinion now, as it was after that initial November meeting, that Colonel Courington was the driving force behind the SAB's routine smoothness and today deserves much of the credit for the successful accomplishment of the 1995 McCall report. His reflective, casual, assured approach to most issues impressed every member of the SAB. If there is a silent hero in this story, it is undoubtedly Tim Courington, now retired from the US Air Force.

While in Washington that November, I had the opportunity to interview several of the SAB members, both past and present. It was a researcher's dream come true. In the same room sat two original SAG members, several past SAB chairmen, many retired USAF officers who had dealt directly with the SAB at all levels, the most outstanding being Gen Bernard Schriever and Gen Lew Allen Jr. General Arnold had participated in Schriever's wedding, and Kármán worked for him when he directed the development of the USAF intercontinental ballistic missile (ICBM) program. Allen was a former Air Force chief of staff and after retirement had directed the Jet Propulsion Laboratory (JPL), the same organization founded by Kármán in the Arroyo Seco of California in the late 1930s. Other notables were Dr. Ivan Getting, the father of the global positioning system (GPS); Dr. Court Perkins, a masterful storyteller and former chief scientist of the Air Force; Mr. Chet Hasert, a Kármán student, European companion, and original SAG member; and Dr. Ed-

Col Tim Courington, at right, welcomes Dr. Richard Hallion, Air Force historian, and Gen Ronald Fogleman, Air Force chief of staff, to the 50th anniversary celebration of the Scientific Advisory Board, November 1994.

Dr. Edward Teller, Dr. Gene McCall, and Dr. Court Perkins during the awards ceremony at the 50th anniversary gathering

The Arnold "apparition" in the balcony at the NAS that evening

ward Teller, coinventor of the "dry" hydrogen bomb that made the ICBM a practical weapon. General Arnold himself even appeared as an "apparition" from the balcony at the banquet in the NAS that night as part of the entertainment program.

The keynote speaker for the symposium was Secretary of Defense William Perry. Although Vice President Al Gore was supposed to kick off the afternoon session, last-minute priorities canceled his appearance. In any event, interest in the Scientific Advisory Board was and remains keen within the federal government.[2]

During early November, Dr. Widnall and the Air Force chief of staff Gen Ronald Fogleman (trained in history at Duke University)

formally issued their "New World Vistas" challenge to the SAB in a two-page memo dated 29 November 1994. This sequence was reminiscent of a legendary Arnold/Kármán meeting at LaGuardia Airport back in August 1944. It was at that meeting that Arnold convinced Kármán to write the first S&T forecast for the Army Air Forces. Kármán accepted the challenge, but it was not until 7 November that Arnold got around to putting his request down on paper. My point in recounting these events is to demonstrate that the origins of *New World Vistas* were steeped in the realization and recognition of historical events and Air Force traditions—traditions that began before the Air Force became an independent service. The study itself was to be guided by principles similar to those that Kármán used in the first report. The 16 speeches given at the 50th anniversary symposium throughout that November day traced the chronology of the SAB and were not only informative but at times nostalgic.[3] Further, the NAS setting, near a supersized statue of Albert Einstein, helped set an atmosphere of inspiration and imagination for several of the SAB members.

During the first week of February 1995, Dr. McCall finalized plans for the study's format with Dr. Widnall. She insisted that the report should pursue joint service involvement, simulation, and modeling opportunities and should investigate areas where "explosive rates" of technological change might affect the Air Force. Widnall's and Fogleman's November tasking letter quoted Kármán's directly: "Only a constant inquisitive attitude toward science and a ceaseless and swift adaptation to new developments can maintain the security of this nation."[4]

Answering the call to proceed immediately, Dr. McCall selected Maj Gen John Corder, USAF, Retired, not a scientist himself, as his deputy.[5] A stark contrast existed between these two men. Corder represented the task-minded side of the *New World Vistas* lead-

Gen Ronald R. Fogleman addressed the SAB members, past and present, at the gathering at the NAS on 10 November 1994.

Secretary of the Air Force Sheila E. Widnall enjoyed the formal gathering at the NAS on the evening of 9 November 1994.

ership. McCall represented the typical scientist: thoughtful, not overly mindful of time schedules, relaxed in the extreme. This pairing was similar to the original SAG's top two. Kármán had selected Dr. Hugh Dryden, longtime chairman of the National Bureau of Standards, an excellent administrator. Kármán, often introspective and self-described as "always late," was counterbalanced by the well-organized Dryden.[6] The McCall/Corder team held similar balance.

Over the next four months, McCall and Corder selected panel chairmen and held preliminary meetings. By mid-March, the panels were formed (although some changes occurred during the course of the study), and some even met in full session to jump-start the investigation process.

On 10 April, the panel chairmen gathered near Dulles Airport at Westfield's, a luxury meeting facility. The committee chairs gave a brief summary of their preliminary efforts, and a few outsiders delivered specific briefings designed to broaden ideas on S&T forecasting. Of note were presentations by Dr. Peter Bishop, who discussed "alternative futures." This was a true "out of the box" attempt at looking toward the future. Dr. Clark Murdock, deputy special assistant to the Air Force chief of staff on long-range planning, also made a presentation, more conventional but still an attempt to open the panel chairmen's minds to possibilities for envisioning the future. Earlier in the year, John Anderson, a National Aeronautics and Space Administration (NASA) long-range planner, had briefed panel chairmen on his "Horizon Mission Methodology," a "future-to-present" approach to forecasting. The attendees left with an introduction to forecasting that appeared new and far reaching. From my observations, the majority of the panels did not use these methods in their entirety but incorporated portions of them at certain points during the study.

Next, from 2 to 5 May, the SAB general membership meeting took place at Maxwell AFB, Alabama. This meeting, although not specifically designed as a *New World Vistas* panel workshop, turned out to be one of the most significant events in the yearlong process. Specialists from across the United States, as well as the SAB membership, were invited to participate in working groups that addressed "broad technical and mission areas."[7] It was during this meeting that the 12 *New World Vistas* panels utilized their time and roughed in preliminary approaches to their specific reports. The rough draft was to be completed by the end of the SAB summer study held in Newport Beach, California, in July—a short three months away. Thus, it was with the help of many nonpanel members—outside of the *New World Vistas* formal structure—that preliminary ideas for the report were developed and shared.

From 10 to 21 July, the *New World Vistas* panels convened in the lovely surroundings of Newport Beach. *Vistas* consisted of six technology panels and six applications panels. The meeting place was the NAS's Beckman Center in Newport Beach, which had been equipped with a network mainframe linking all of the separate panel computers together. Each room was equipped with laptop computers, and each computer was linked to the other. The idea was to simplify and speed up the final editing process. Compared to the SAG working environment of 50 years earlier, this high-technology atmosphere certainly reflected changes in American society as well as within the scientific community. Kármán's group worked with slide rules and manual typewriters. There was only one electric typewriter in the Beckman Center, and the only slide rule might have been found in a display case of old scientific paraphernalia.

The *New World Vistas* study had seven primary objectives:

1. Predict how the explosive rate of technological change will impact the Air Force over the next 10 to 20 years.
2. Predict the impact of these technological changes on affordability.
3. Predict science and technology areas where dual-use defense conversion occurs, industry leads and military follows, and a partnership with industry exists.

4. Predict S&T areas the Air Force will have to develop where no commercial market exists.
5. Offer advice as to whether our lab structure is consistent with the study and what changes, if any, should be made.
6. Offer advice as to whether the current SAB charter is consistent with the findings of the study and what changes, if any, should be made.
7. Evaluate the study in light of how the Air Force contributes to the joint team.

During the length of the study, a World Wide Web page allowed interface directly with the American public. This is, perhaps, the most remarkable aspect of *New World Vistas*. The vast majority of the report is unclassified. One classified volume that incorporates all of the classified portions of all of the panel's reports does exist. Kármán's original study was classified at such a high level that fewer than a hundred copies were distributed, and it remained classified for nearly a decade. Dr. Ivan Getting, also a member of the first SAG study, recalled that the classification of the original report made it nearly useless outside of Air Force circles.[8]

Inexorable links to the civilian, commercial world precluded any serious thought about a restrictive classification. But the nature of S&T has changed dramatically since 1945. Today, the Air Force is becoming a customer of industrial technology, whereas in the past the Air Force (indeed, the military in general) pushed the technological process.

By the end of July, a firm timetable had been established for finalizing the *New World Vistas* report. Corder hoped that the report might be finished by the first week in November. Remarkably, all but Dr. McCall's *Summary Volume* were in final draft form by Thanksgiving. The 15 December report deadline was rapidly approaching, and those handling the final printing process were working long, hard hours to have the report in its final form for the secretary of the Air Force's meeting deadline. Completion was just not possible. The S*ummary Volume* had seen several edits during the first week of December amidst stiff

Ivan Getting, father of the global positioning system

discussion by panel members over its content. After some last-minute alterations, the *Summary Volume* was published in enough quantity to ensure that the secretary of the Air Force and all visiting senior staff members received one. In all fairness, the first draft of the S*ummary Volume* had been released to the panel chairs in August for their comments. It was the difficulty of incorporating the comments from 12 different sources that slowed the *Summary Volume*'s completion. But the majority of reports had not been published in final form. In fact, the volumes piled upon the briefing table on 15 December were simply the draft copies of the panel reports, nicely bound by Air Force graphics.

Kármán's report, although placed on Arnold's desk on 15 December 1945, was only the final draft of the executive summary "Science: The Key to Air Supremacy." The copy of all 33 sections, in 12 volumes, was not finalized until early spring the following year.

Nonetheless, the process of publicly releasing McCall's report began with much fanfare on 31 January 1996. Secretary Widnall and Dr. McCall held a national press conference in the Pentagon to explain the purpose of *New World Vistas*. Dr. Widnall assured reporters that "this report will not sit on the shelf and gather dust."[9] Prime-time reports

Left to right, *Dr. Edward A. Feigenbaum, Gen Ronald R. Fogleman, Deputy Secretary of Defense Paul Kaminski, Secretary of the Air Force Sheila Widnall, and Dr. Gene McCall, November 1994*

aired that evening on "ABC World News Tonight with Peter Jennings" and Cable News Network (CNN). Newspapers across the country also carried stories covering the *New World Vistas* report via United Press International (UPI) and Reuters News Agency press releases. The results of the report are also part and parcel of *Air Force 2025*, an Air University project that emphasized planning for the future of the Air Force. The multiaxis approach to forecasting in the Air Force—several studies and agencies working long-range planning issues concurrently—was also an Arnold creation. In 1945, Arnold funded the first RAND studies, established the Office of Scientific Liaison headed by Col Bernard Schriever, and established a separate Research and Development Directorate headed by Gen Curtis E. LeMay.

As with any forecast, some portions will prove right and some wrong. Kármán's 1945 report, for example, did not envision the impact of the computer on the Air Force. But then it seemed that few saw a great need for computers in the age of the slide rule. There is a certain irony in the fact that the chief scientist of the Air Force during the *New World Vistas* study, Dr. Edward A. Feigenbaum, was a computer scientist. Feigenbaum was the first Air Force chief scientist from that discipline and also *New World Vistas* chair of the Information Technology Panel.

In regard to the first SAG study in 1945, there were significant long-term impacts on the fledgling Air Force. Eventual "fallout" included (1) establishment of a permanent Scientific Advisory Group in 1946 strengthened by its reorganization in 1948; (2) establishment of the Air Research and Development Command (ARDC) in 1950; (3) establishment of the Arnold Engineering and Development Center (AEDC) in 1951; (4) creation of the US Air Force Academy in 1956; and (5) establishment of a number of specific development programs, particularly the Air Force ICBM program.[10] These were all fruits of Kármán's intellectual seed. In fact, the institutionalization of science and technology permeating today's Air Force can trace its origins to Kármán's two major reports for General Arnold in August and December 1945.

The conclusions drawn in *New World Vistas* may one day have similar reach as those of Kármán's first study. Perhaps in a decade we will have an idea of their impact. Following is a summary of these conclusions:

1. There will be a mix of inhabited and uninhabited aircraft. Specifically, the Uninhabited Combat Aerial Vehicle (UCAV) will fill many roles and expand performance into the hypersonic range, enabling strikes anywhere on the globe within minutes.
2. Large and small aircraft will project weapons. "Large" aircraft will be the first to carry directed-energy weapons and, eventually, will carry smaller UCAVs internally, providing intercontinental standoff capability. The roles of this type of vehicle will reach into space as well.
3. We must extend airlift capabilities. Expansion of airlift fleets will need to include "point-of-use" delivery capability. Essentially, this means improving precision airdrop capability to keep up with the increased tempo of operations in any future endeavor. "The problem of airdrop should be treated as seriously as the problem of bomb drop."
4. The future force will become efficient and effective through the use of information systems to enhance US operations and confound the enemy. Information and space will become inextricably entwined. The human-machine interface must also improve as the machines improve. "Information munitions" will become part of the inventory just as laser-guided bombs, infrared missiles, or cruise missiles are today.
5. Space and space systems will become synonymous with effective operations. The protection of our assets and the denial of capabilities to an enemy will be essential.
6. Sensors and information sources will be widely distributed. In the past, there has been a failure to recognize that information originates as data from active and passive sensors. New information systems will correlate data into information much more effectively than before.

Dr. McCall also added a few cautions to those who read only the *Summary Volume*. First, affordability must not be eliminated from the overall picture. Second, and extremely important, operational components of the Air Force must plan jointly—that is, with "each other, other services, and allies." The expanding information network should make this easier in time as "internetting of nodes" becomes more and more seamless.

It is also interesting to note a few of the general guidelines that are attached to the end of the second chapter. Two in particular struck me as significant to the ultimate success or failure of this venture. It is important that all Air Force members be aware of these as potential stumbling blocks to the ultimate implementation of recommendations from this report.

1. Identification and development of revolutionary concepts require intuition, innovation, and acceptance of substantial risk.
2. Most revolutionary ideas will be opposed by a majority of decision makers.[11]

Clearly, Dr. McCall was suggesting that without bold, creative, high-level leadership, the ultimate success of *New World Vistas* might be at risk. The implication was that in a massive bureaucratic organization like the Air Force, technological change is dependent upon a certain amount of "out-of-the-box" thinking and acceptance of some failures along the way. Whether Air Force leadership, in light of the constant battle of the budget, can make such a leap remains to be seen.

This brings us back to the historical aspects of this report and a statement made by General Arnold back in 1946:

> Successful research, being the product of inspiration, cannot be purchased like a commodity. It is the product of the human mind—of intellectual leadership. . . . All of the funds and facilities devoted to research will be wasted unless at the same time America possesses competent

> intellectual leadership. . . . The proper cultivation of the human mind is the essence of the task.[12]

The continued evolution of the Air Force as a technological megasystem within the boundaries of a complex American society has been determined by the realities inherent in Arnold's statement during these past five decades, and it will depend on innovative, command-level leadership for the next five decades.

Arnold's words might remind us that, although some elements of military technology may change, other elements remain painfully the same. Perhaps it was Kármán who was most prescient when he said, "A report does not make a policy. It depends on the administration."[13] McCall has taken that thought one step further. It is McCall's opinion that to be effective and successful, this report must be kept alive through several generations of senior Air Force leadership.[14] Only time will reveal whether or not McCall's perceptions and desires for his report will compare favorably with Kármán's prescience. Perhaps McCall's own words are best repeated here: "Forecasting is not an exact science, and the path will wind as it disappears into the shadow of the future. We guarantee the journey to be productive even if the road ends in an unexpected place."[15]

Since the release of *New World Vistas* in January 1996, the volumes have found their way into Pentagon offices that drive programs—from doctrine to procurement—and into Air Force laboratories where *New World Vistas* projects lace the working docket—from lasers to special materials programs. To judge the *New World Vistas* forecast a success or failure after over five years would certainly be premature; however, construction is under way for the future, even if the road's end is not yet in sight. □

Notes

1. For a summary of the first five studies, see Dr. Michael Gorn's *Harnessing the Genie: Science and Technology Forecasting for the Air Force, 1944–1986* (Washington, D.C.: Office of Air Force History, 1989). This article is a summary of the author's observations made during 1995. He was assigned to the SAB staff as a historical advisor for a videotape produced by Air Force Television that documented the history of the SAB and examined the relationship of Air Force S&T and its impact upon and relationship to the civilian world. To review Kármán's 1945 reports to General Arnold in their entirety, see the appendices in Dik Daso, *Architects of American Air Supremacy: Gen Hap Arnold and Dr. Theodore von Kármán* (Maxwell AFB, Ala.: Air University Press, 1997).

2. Col Timothy Courington to Dr. John McLucas, memorandum, subject: [Scientific Advisory Board], 18 July 1994, SAB files.

3. The *Ancillary Volume* of the *New World Vistas* study contains the 16 speeches, a number of interviews done with many of the study's participants, as well as several long-term forecast essays written anonymously by members of the *New World Vistas* panels. *New World Vistas: Air and Space Power for the 21st Century: Ancillary Volume* (Washington, D.C.: USAF Scientific Advisory Board, 1995).

4. Memorandum for Lt Gen Richard Hawley, subject: [*New World Vistas*], 13 February 1995, SAB files.

5. General Corder's reply to Dr. McCall was excellent. "Wow," it began, and then expressed a keen awareness of the monumental task at hand while accepting the position. On file in SAB (1994) files.

6. Theodore von Kármán, interview with Shirley Thomas, January 1960, audiotape recording, Indiana University Special Collections.

7. Dr. Gene McCall to SAB members, ad hoc advisors, and invitees, 17 March 1995, SAB files.

8. Dr. Ivan Getting, interview with author, tape, National Academy of Sciences, 9–10 November 1994.

9. Dr. Sheila Widnall, press conference, videotape, Pentagon, 31 January 1996.

10. Teddy Walkowicz, "USAF Scientific Advisory Board: Hap's Brain Child," *Air Force Magazine*, June 1955, 50–54. Walkowicz wrote, "In a very real sense, this report was a product of the intimate friendship, confidence and mutual respect between the soldier and the scientist: Arnold and Kármán. Each explored the other's mind, and their associates left behind a legacy of imaginative, yet scientifically sound, planning to help insure the qualitative supremacy of American airpower." The second and third of these were the result of the Ridenour/Doolittle Report, September 1949, which recommended their development, among other reforms in Air Force science.

11. See *Summary Volume*, chapter 1, 3–13, in Dr. Gene McCall, *New World Vistas: Air and Space Power for the 21st Century*. This entire volume is only 70 pages long, not including appendices, and should be required reading for all Air Force personnel. Copies may be obtained through the USAF/SAB, Pentagon.

12. H. H. Arnold, "Science and Air Power," *Air Affairs*, December 1946, 190.

13. Theodore von Kármán, interview with Donald Shaughnessy, Columbia University Oral History Interviews, US Air Force Academy, Special Collections, Colorado Springs, Colorado, 10.

14. Dr. Gene McCall, interview with author, Beckman Center, Newport Beach, California, videotape, 13 July 1995.

15. *Summary Volume*, 54.